



Integrated Barbell Weighing Device for Strength Training

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Tracking progress in sports, such as Running and Cycling is extremely common... So why is there nothing similar for Strength Sports

Motivation

Strength training has grown in popularity over recent years. With many people now regularly training in gyms with a focus on specialities, such as Bodybuilding and Powerlifting.

Sports such as Running, Cycling and Swimming, have all seen in recent years an enormous growth in tracking software. Companies and Products such as Apple Watch, Fitbit and Strava, all provide very easy to use ways to track these activities and collect useful information.

The same can't be said for Strength Training, hence a device that tracks a user's workout along with provide relevant and useful information could fill a gap in the market.

Background

Powerlifting is a sport where the aim is to lift as much weight as possible in three lifts. The Squat, Bench Press and Deadlift:



Squat



Bench Press



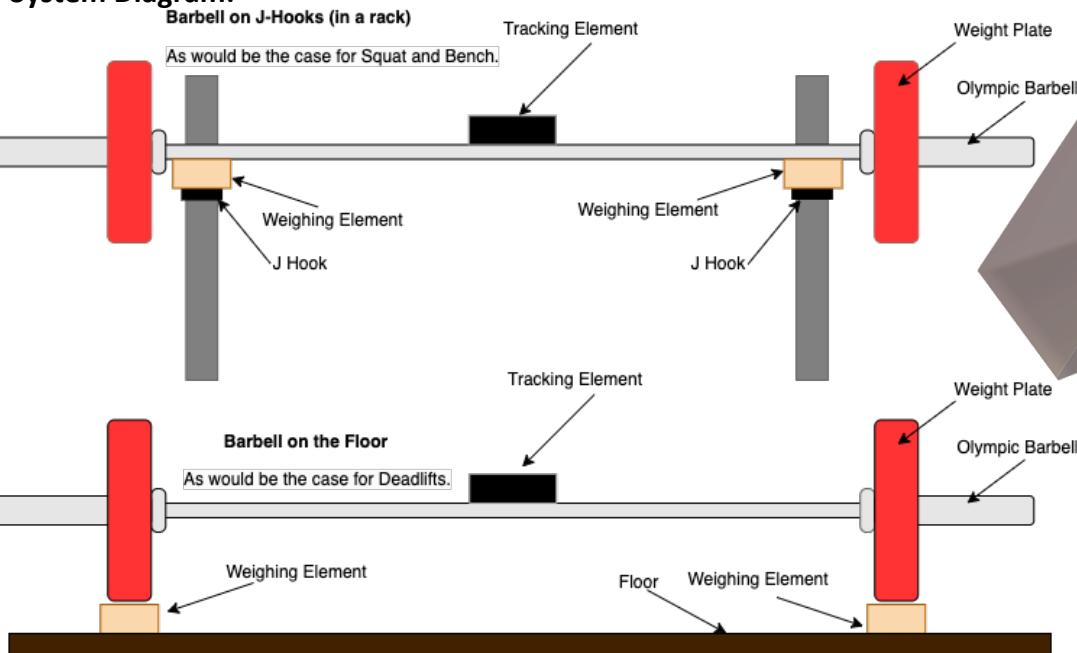
Deadlift

- In powerlifting competitions calibrated plates are used. These are very accurate weight plates that are within $\pm 10\text{g}$ of the stated value. Regular weight plates aren't made to the same tolerance and can be up to $\pm 10\%$ off the stated value.
- This leads to uncertainty in training, if you are training for a Powerlifting Competition or 1 Rep Max then this 10% tolerance can be a big issue.
- There are a number of strength training apps that allow users to track their lifts but the majority of the data has to be input manually by the user which is time consuming and laborious.
- There is a large body of research that focuses on tracking strength training movements, unfortunately a large amount of this is based around workout gloves, which divide opinion and aren't popular with many users.

The Run Down

Create a system that can Weigh an Olympic Barbell in a live gym environment, along with count the reps and sets that a user can perform. This data can then be displayed and logged on a mobile Application, where processing and coaching could take place.

System Diagram:



Project Objectives

- The devices are able to perform weight measurements of an Olympic Barbell loaded with plates with a focus on performing this weighing functionality in the Squat, Benchpress and Deadlift.
- These devices should also include the ability to track the Barbell path as it moves, this allows accurate repetition and set counting.
- The data these devices collect is then processed and displayed in a smart phone application. Where the user can see the repetitions and sets they have performed of each of the different compound lifts along with enter any data that the app requires.

Method

This project involved designing and manufacturing these devices from the ground up:

- Hardware Specification and Selection
- Customs PCBs designed, fabricated and assembled
- Scripts written for the Weighing and Tracking Elements
- Custom iOS App Written
- Enclosures were designed and 3D Printed from Polycarbonate
- Thorough Testing procedure followed

Conclusions

The devices were put through a testing procedure including loading 450kg onto the enclosures. The rep and set functionality performed very well but further optimisation to minimise mis counts is needed. An especially difficult part of the tracking is the detection of un-racking and re-racking motion that needs further characterisation. Overall this method has great promise and sets the stage for further development.

